Sales decline

We usually encounter problems about sales decline when we study exponential growth and decay, because sales decline can sometimes by modeled by an exponential decay equation.

In order to model sales decline with the exponential decay equation, the decline must have a constantly and exponentially rate of decline. If it does, we can use our standard exponential change equation.

The general formula for calculating sales decline is

$$C_f = Ce^{rt}$$

where C is the original amount, r is the rate of decline, and C_f is the final amount after time t. It's important to remember that the rate r and the time t need to have complementary units. As an example, if r is a given rate *per month,* then time t needs to be measured in *months*. If r is in years, then t should be in years also. If the units don't match, you'll need to convert one to match the other.

Example

Einstein poster sales have decreased over the past 4 years. Four years ago, Einstein posters sold $285{,}674$ units. Over the last year, sales were only $97{,}546$ units. Assuming that sales have declined at a steady exponential rate, what is the rate of decline of the sales of Einstein posters?

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We'll use the general formula for sales decline,

$$C_f = Ce^{rt}$$

We know that fourth year sales are $C_f = 97{,}546$, and that first year sales are $C = 285{,}674$. Time is $t = 4$ and we need to calculate r.

$$97{,}546 = 285{,}674e^{r(4)}$$

$$\frac{97{,}546}{285{,}674} = e^{4r}$$

$$0.3415 = e^{4r}$$

$$\ln 0.3415 = \ln e^{4r}$$

$$-1.075 = 4r$$

$$r = -0.269$$

Sales of Einstein posters declined at a rate of -0.269 per year.

Let's try a more complex example.

Example

Environmental awareness over the last decade has had a negative impact on some consumable products. One year ago $5{,}698$ units of disposable sandwich bags sold in one month. An environmental group noted that over

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the last 12 months, disposable sandwich bag sales have decreased at a steady exponential rate of -0.015 per month.

1. How many units of disposable sandwich bags were sold last month?

2. Assuming that the rate of decline held steady, how many disposable sandwich bags would we predict would be sold six months from today?

We'll use the general formula for sales decline,

$$C_f = Ce^{rt}$$

The rate of decline is $r = -0.015$, the original amount is $C = 5{,}698$, the time frame for the first question (last month) is $t_{\text{last month}} = 12$ and the time frame for the second question (6 months in the future) is $t_{\text{in 6 months}} = 18$.

So we can say

$$C_{\text{last month}} = 5{,}698e^{-0.015(12)}$$

$$C_{\text{last month}} = 4{,}759$$

In the past month, $4{,}759$ units of disposable sandwich bags were sold.

And

$$C_{\text{in 6 months}} = 5{,}698e^{-0.015(18)}$$

$$C_{\text{in 6 months}} = 4{,}350$$

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Assuming our rate of sales decline remained the same, six months from now monthly sales of disposable sandwich bags will be $4{,}350$ units.

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